

# **CHIP FOR LARGE-SCALE USE OF INDUSTRIAL GENOMICS IN HEALTH AND AGRICULTURE AND METHOD OF MAKING SAME**

This application is based on and claims priority from provisional application  
Serial No. 60/247,325 filed November 10, 2001.

## **TECHNICAL FIELD**

The present invention is directed to a product in the form of a chip for  
functional genomics for DNA testing and which holds or carries DNA samples and the  
method of making same. A preferred chip would have a hydrophobic field and hydrophilic  
pads within the field to hold the DNA.

## **BACKGROUND OF THE INVENTION**

Attempts to manufacture a chip of this type for functional genomics by plasma  
dispositions and not requiring silation of the fields could produce the hydrophobic field but  
proved to be unstable, non-repeatable and resulted in a low yielding and poor quality of  
product.

With the present invention, it has been possible to produce a hydrophobic  
fluorene polymer coated wafer with exceptional characteristics. The process of the present  
invention eradicates the instability and variability of organic pads, eliminates the need to  
alter the surface of previously produced chips via vapor silation methodology prior to  
depositing matrix and analyte and increases the hydrophobicity delta between field areas  
and silicon pad analysis areas.

## **DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a flow chart showing the steps of one process of making a chip of the  
present invention.

Fig. 2 shows the parameters of the hydrophobic coat process.

Fig. 3 shows the parameters of etching the pad areas to the oxide wafer.

Fig. 4 shows a cross section of a chip made in accordance with the process of Fig. 1 and with the pad area etched to the oxide.

### DETAILED DESCRIPTION OF THE INVENTION

5 Referring now to Fig. 1, the preferred embodiment of the process of the present invention starts with an 8-inch silicon wafer, polished on one side with the thickness of  $725 \pm 25 \mu\text{m}$  in step 1 of Fig. 1.

10 In step 2, the wafers are placed in a high temperature diffusion furnace such as a THERMCO and oxidized to produce a thermal oxide of  $1000 \text{ \AA}$  to  $20,000 \text{ \AA}$ . In the preferred embodiment of the invention a thermal oxide of  $3060 \text{ \AA} \pm 60 \text{ \AA}$  is produced at a temperature of  $1,000^\circ\text{C}$  and a gas ratio  $\text{H}_2\text{O}_2$  1.8:1 with a specific preferred blue color.

If it is desired to place a legend, identifier or logo on the chip it can be performed in a fairly typical series of steps.

15 Next a hydrophobic fluorene polymer coating is applied in step 3. The preferred coating is Cytonix made by Cytonix Corp. of Beltsville, Maryland. The Cytonix coating is applied such as by using a SVG 90 track (Ser. # 5209 CAB-08). The target thickness may be  $300 \text{ \AA}$  (post-bake) but preferably is reduced in step 4 to about  $100 \text{ \AA}$  and air-dried in step 5 before the bake cycle.

20 The next Cytonix bake/cure step is accomplished such as using SVG90 track (5209 CAB-08) at  $200^\circ\text{C}$ . Preferably, the wafer is positioned in proximity such as 10 millimeters from and not in contact with the baking plate as step 6, and incrementally lowered to full contact followed by total bake time of 15 minutes in step 7. The proximity placement and incremental lowering avoids wafer film anomalies and produces a more esthetic appearance. The parameters of the coating step 3 and baking step 4 are shown in Fig. 2 where the exhaust is measured in liters/hour.

25 In accordance with the preferred embodiment of the present invention, a disposable "one-time use chip" is produced. This portion of the process and the product

are illustrated in Figs. 3-4. This process and the product produced thereby increases the hydrophobicity delta between the analysis pad and the field area over the prior art.

For masking and producing the desired number of pads, the wafers are coated and baked in steps 8-11 and as shown in Fig 3, such as on a MTI FlexFab (62-E1-2453) preferably using positive photo-resist with thick viscosity. The bulk thickness of positive photo-resist is reduced to less than 1.0  $\mu\text{m}$  if the resist pads are used for matrix deposition by placing wafers in a developer solution that incrementally removes photo-resist material.

In step 9 the photo-resist is printed such as on an UltraTech 2150 XLS Stepper using the positive resist process and positive develop process shown in Fig. 3 by post exposure bake using MTI FlexFab (62-E1-2453) and development such as using a Shipley MF-701 developer followed by a rinse and dry in step 12.

In this process, the etch step designated 13 removes just the hydrophobic Cytonix coating from the "open" analysis pad area, such as by using a barrel or single wafer etch chamber with  $\text{CF}_4/\text{O}_2$  gas. This results in a one time use chip with the hydrophobic field area exhibiting contacting angles of greater than  $110^\circ$  and the hydrophilic analysis pad verified to measure less than  $50^\circ$  (after removal of the photo-resist).

Fig. 4 shows a cross-sectional view of the disk produced by the process including the silicon wafer 31, oxide layer 32 and the hydrophobic field 33 and with the pads 34 extending down to the oxide layer 32.

The hydrophobicity of the Cytonix coated (oxidized) wafer is verified in step 14 by depositing several droplets of deionized water onto the wafer surface. The repellant (contact) angle should measure greater than  $110$  degrees. Finally the photo-resist is removed in step 15 and the wafer sliced and diced in step 16.